	Works Information	Generation
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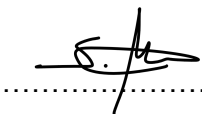
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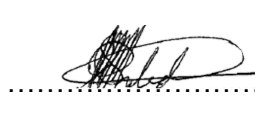
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PART 3: SCOPE OF WORK

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C3.1	<i>Employer's Works Information</i>	
C3.2	<i>Contractor's Works Information</i>	
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C3.1: EMPLOYER'S WORKS INFORMATION

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3 Engineering and the Contractor's design

3.1 Employer's design

The Outside Plant Hitachi Energy MicroSCADA system is located at the Electrical Operating Desk (EOD), and fulfils the supervisory control functions necessary for the control and monitoring of the following plant areas, namely:

1. Automatic Generation Control (AGC) RTU.
2. Generator Plant (Generator Plant A & B RTU)
3. 275kV Switch Yard (275kV RTU).
4. 400kV Switch Yard (400kV RTU).
5. Outside Plant (Outside Plant RTU).

The scope of this project as documented herein focuses only on the AGC, Generator Plant A and Generator Plant B RTU replacement. It aims to ensure that the completed system is fully operational as per the functional requirements of the interfaced systems.

3.1.1. The AGC RTU

The AGC RTU controls system receives signals from National Control via the Bandwidth Management Equipment (BME) located at the High Voltage (HV) Yard. The command signals are routed from the BME to the AGC RTU control system via a single mode fiber optic cable. From the AGC RTU control system, signals are hardwired to the ABB P14 Unit Distributed Control System (DCS) via the Intermediate Distribution Frame (IDF). The communication between the AGC RTU and the Units DCS is one directional. This means that commands from National Control (NC) to the Unit DCS are sent from the AGC RTU to the Unit DCS, but no signals are sent back from the Unit DCS to the AGC RTU. The *Contractor* maintains the one-directional communication architecture unless instructed otherwise by the *Project Manager*.

3.1.2. ABB P14 Unit Control DCS System

The Unit DCS executes commands from National Control or from the Unit Controller via the AGC RTU. It is responsible for ramping Unit load up or down as requested by National Control or by the Unit Operator. The ABB P14 DCS forms part of the *Employer's* existing design and infrastructure.

The *Contractor* does not modify, alter, or interfere with any ABB P14 DCS hardware, software, configuration, or logic unless expressly instructed in writing by the *Project Manager*. Any integration, communication, or configuration work required to achieve full functionality between the RTU and the ABB P14 DCS is carried out by the *Contractor* through a subcontract with ABB South Africa (Pty) Ltd or an ABB-authorized representative.

No modification to the ABB P14 DCS, whether hardware, software, or configuration may be undertaken without prior written acceptance from the *Project Manager* and confirmation of compatibility from ABB South Africa (Pty) Ltd. The *Contractor* remains responsible for coordinating all necessary technical interfaces, verifications, and documentation required to achieve a fully functional and compliant interface.

3.1.3. Generator Plant A and B RTU

The Generator Plant A RTU and Generator Plant B RTU form an integral part of the Station Electrical Reticulation system. They perform both control and data-acquisition functions for the electrical reticulation network, including the operation and status monitoring of switchgear, feeders, and associated auxiliaries. The RTUs interface with the *Hitachi Energy MicroSCADA* system via the AGC RTU using the *IEC 60870-5-101* networked protocol. The replacement RTUs retain the existing control and operating philosophy, operational logic, and data-mapping structure to ensure full compatibility and continuity of operation within the Station Electrical Reticulation Control System.

3.1.4. The Concentrator (Main RTU)

The three *RTU Control Systems*, namely the *AGC RTU*, *Generator Plant A RTU* and *Generator Plant B RTU*, use the *ESTEL* protocol for intercommunication. However, they communicate with the *Hitachi Energy MicroSCADA* system and the BME using the *IEC 60870-5-101* protocol, as defined in the *Eskom Slave Device IEC 60870-5-101 Implementation Standard (240-61478980)* and the *Eskom Master Device IEC 60870-5-101 Implementation Standard (240-61478967)*.

A cubicle, referred to as the *Concentrator*, is located between the *AGC RTU* cubicle and those of the *Generator Plant A RTU* and *Generator Plant B RTU*. The *Concentrator* cubicle contains one (IST) module and an associated power supply. Its purpose is to translate between *ESTEL* and *IEC 60870-5-101* protocols.

As the *replacement RTUs* are required to be fully compatible with the *IEC 60870-5-101/104* protocol, the existing *Concentrator* will no longer be required as part of the control systems with replacement RTUs supplied and installed by the *Contractor*.

3.1.5. HV Yard BME

Information is exchanged between National Control and the AGC RTU at Arnot Power Station via the BME located at the HV Yard. A fiber optic patch panel is installed on the 400 kV ERTU located in the 400 kV Relay House at the HV Yard, which provides the physical interface between the BME and the AGC RTU located in the IDF Room on the second floor of the Main Building.

Information is transferred in both directions between the BME and the AGC RTU through software and hardware interfaces using the *IEC 60870-5-101* protocol, as defined in the Eskom Implementation Standards for Master and Slave Devices.

As part of the SAT, the *Contractor* verifies and demonstrates successful communication between the BME and the replacement AGC RTU, ensuring full compatibility and continued operability of the *Employer's* existing RTU control system.

3.1.6. Power Supplies

The existing RTUs are powered from redundant 220 V AC power supplies. These power supplies are sourced directly from a DB located adjacent to the RTU cubicles in the IDF Room. The DB receives power from two of the Units' Uninterruptible Power Supplies (UPS) situated in separate equipment rooms, EDS 123 and EDS 456.

The *Contractor* designs the replacement RTUs to operate using the existing redundant UPS power supplies. The *Contractor* installs appropriately rated circuit breakers and associated protective devices within the existing DBs to provide adequate protection and isolation for the replacement RTUs. Any modifications to the DB required for the integration of these protection devices are carried out by the *Contractor* in accordance with the *Employer's* electrical standards and subject to the *Project Manager's* acceptance.

3.1.7. C&I Rooms

The *Employer* provides the following C&I rooms:

1. Existing equipment rooms
2. Existing control room

The following is provided by the *Employer* for the existing Units equipment rooms:

1. Units ABB P13 & 14 DCS
2. Redundant UPS
3. Battery Chargers
4. HVAC at the IDF Room

3.1.8. Earthing Point

The station earth point is provided by the *Employer*.

3.2 Parts of the works which the Contractor is to design

Except where this *Works Information* expressly states otherwise, the *Contractor* designs the whole of the *Works* including the replacement RTUs forming part of the AGC RTU Control System and the Generator Plant A and Generator Plant B RTU Control Systems to meet the functional and performance requirements specified in the *Works Information*. Defined terms, including AGC, DCS, RTU, HMI, AGC RTU Control System, and Generator Plant RTU Control System, are used with the meanings given in the Definitions section.

3.2.1. High Level Scope of Work

1. The *Contractor* designs, engineers, manufactures, assembles, tests, inspects, packs, delivers, installs, commissions and hands over the replacement RTUs, including all associated I/O modules, communication interfaces and power supply components, as complete and fully integrated replacements within the existing AGC RTU Control System and Generator Plant A and Generator Plant B RTU Control Systems at Arnot Power Station.
2. Supplied systems by the *Contractor* include but not limited to RTU hardware, firmware, software, configuration, cabling, HMI configuration where applicable, documentation.
3. The *Contractor's* design meets Availability, Maintainability and Lifecycle requirements in Section 3.2.4 and the RTU minimum composition and redundancy stated in the Definitions.
4. The *Contractor* supplies the replacement AGC RTU that is compatible with TEMSE (the Energy Management System at National Control), the BME at the HV Yard, the Hitachi Energy MicroSCADA system, and the ABB P14 DCS. The replacement AGC RTU supports AGC operation for Area Control Error (ACE) regulation in accordance with the Generation AGC Design Standard for Power Plants (240-119416400).
5. The *Contractor* replaces the obsolete RTUs with an intelligent controller compatible with Hitachi Energy MicroSCADA, the BME at the HV Yard and the ABB P14 DCS, without degrading existing approved operational philosophies.
6. The *Contractor* provides the software and hardware interfaces between the replacement RTUs and the ABB P14 DCS, Hitachi Energy MicroSCADA, BME, and National Control as required to achieve a fully functional and integrated system.
7. The *Contractor* provides all temporary cabling, networking, equipment, software configurations, and any other temporary *Works* required to achieve a successful online changeover in accordance with Clause 3.2.5 of this *Works Information*.
8. The *Contractor* performs FAT, SIT and SAT on the replacement RTUs and verifies full functional integration with the existing RTU Control Systems in accordance with IEC 62381.
9. The *Contractor* ensures that, upon completion of the *Works*, the RTU Control Systems operate with no loss of functionality, performance, or availability compared to their existing operation prior to replacement. All functions presently supported by the existing RTUs, including but not limited to data acquisition, control, redundancy, communications with National Control, integration with the Hitachi Energy MicroSCADA, and interfaces to the ABB P14 Unit DCS, remain fully operational following installation of the replacement RTUs. Where enhancements or upgrades are proposed, these are compatible with the *Employer's* existing systems and do not compromise ongoing plant operations.

10. The *Contractor* ensures that the overall design is checked and signed by an ECSA-registered Professional Engineer or Professional Engineering Technologist, employed or appointed by the *Contractor*, and certified as competent by the RTU OEM Design Authority for each relevant discipline before submission for acceptance. The RTU OEM Design Authority verifies and endorses the design to confirm compliance with the OEM's technical requirements and undertakes to underwrite the design and correct any major deficiencies identified during testing, commissioning, or operation.

3.2.2. General requirements

1. This *Works Information* defines the functional, architectural, communications, reliability and redundancy requirements applicable to the AGC RTU Control System, Generator Plant A RTU Control System and Generator Plant B RTU Control System. It further defines the interfacing and integration requirements with the existing Hitachi Energy MicroSCADA, the BME located at the HV Yard, and the ABB P14 Unit DCS for unit operation and control, in accordance with the Generation AGC Design Standard for Power Plants (240-119416400).
2. This *Works Information* covers the design, engineering, manufacture, inspection and testing at the manufacturer's works, supply, packing and delivery to *Site*, unloading, storage, in-plant transport, erection, supervision, pre-commissioning, commissioning and performance testing of the replacement RTUs and their associated components and devices, forming part of the AGC RTU Control System, Generator Plant A RTU Control System and Generator Plant B RTU Control System
3. This *Works Information* does not specify every detail of design and construction. It specifies the sizing and quality criteria for the major components, equipment and systems necessary to meet the functional requirements of the *Works*.
4. The general requirements include the following activities and services, which the *Contractor* provides for all *Equipment* and *Works* specified in this *Works Information*:
 - a. The *Contractor* ensures workmanship conforms to the quality standards of the Original Equipment Manufacturer (OEM), recognised international standards and good engineering practice.
 - b. All hardware components provided by the *Contractor* are current, supported products based on recognised industry standards.
 - c. The *Contractor* carries out the basic engineering of all equipment and systems.
 - d. The *Contractor* carries out the detailed design of all equipment and systems.
 - e. The *Contractor* provides engineering drawings, data, instruction manuals, as-built drawings and other information required for review, acceptance and record purposes.

- f. All items and *Equipment* that are not specifically mentioned in this *Works Information* but are reasonably required to deliver a complete and functional replacement RTU system are included in the *Contractor's* scope.
5. This *Works Information* states the minimum hardware and software requirements. The *Contractor* provides hardware and software configurations that are equal to or exceed those of the existing RTU control systems, to meet the technical, functional, performance, availability, maintainability and reliability requirements, and to deliver a complete solution.
6. The *Contractor* designs and manufactures the replacement RTUs in accordance with the applicable codes, standards and requirements specified in this *Works Information*.
7. The replacement RTUs provided by the *Contractor* has the following features:
 - a. The replacement RTU is of proven design and suitable for power plant operation and control.
 - b. The replacement RTU is modular and scalable, allowing for expansion by adding new control modules such as power supply modules, CPU modules, communication modules, communication interface modules and I/O modules.
 - c. The replacement RTU is capable of high-speed communication and communicates with multiple sub-RTUs, IEDs and the Hitachi Energy MicroSCADA.
 - d. The replacement RTU rack shall comply with the ingress protection (IP) requirements specified in Standard 240-56355731: Environmental Conditions for Process Control Equipment Used at Power Stations and shall otherwise conform to all other applicable requirements of this standard.
 - e. The replacement RTU supports multiple signal types.
 - f. The replacement RTU modules are hot-swappable.
 - g. The replacement RTU is designed on microprocessor-based technology.
 - h. The control architecture supports pluggable modules on the backplane to ease maintenance.
 - i. Field wiring is terminated on detachable plug-in connectors to allow easy removal from I/O modules.
8. The *Contractor* takes full responsibility for the design and engineering of the *Works* and ensures that a fully functional solution is implemented and proven. All designs and engineering are reviewed and approved by both the RTU OEM design authority and an ECSA-registered professional engineer or technologist employed or appointed by the Contractor, in accordance

with the Engineering Profession Act, 2000 (Act 46 of 2000), prior to submission for acceptance by the *Project Manager*.

3.2.3. Basic RTU Functions

1. The replacement RTUs, supplied and installed by the *Contractor*, perform all control and monitoring functions required for the operation of the AGC, Generator Plant A and Generator Plant B in the same manner as the existing RTUs. The *Contractor* provides all functional capabilities specified in this *Works Information* and designs, engineers and delivers the replacement RTUs as complete, compatible and fully integrated solutions within the existing RTU Control Systems.
2. The basic functions of the RTU Control Systems, as implemented through the replacement RTUs supplied by the *Contractor*, consist of the following as a minimum:
 - a. The Central Processing Unit (CPU) of each replacement RTU is configured with full redundancy.
 - b. The power supply system of each replacement RTU is configured with full redundancy.
 - c. Each replacement RTU includes redundant 220 V AC power supply modules.
 - d. The communication system of each replacement RTU is configured with redundancy for all critical links.
 - e. The replacement RTUs perform all analogue and binary data acquisition, control processing and actuation commands as per the existing RTU Control Systems.
 - f. Each replacement RTU acquires data and exchanges signals through field instruments, transmitters, and hardwired interfaces in accordance with the Generation AGC Design Standard for Power Plants (240-119416400). The *Contractor* provides the following input/output (I/O) capabilities as a minimum:
 - i. Binary (status) signal acquisition.
 - ii. Digital input modules.
 - iii. Digital output modules.
 - iv. Analogue input modules.
 - g. Each replacement RTU receives and processes digital and analogue commands and communications from the Hitachi Energy MicroSCADA for operator supervision, control, monitoring, and alarming.
 - h. The replacement RTUs maintain control and communication with the Hitachi Energy MicroSCADA as part of the integrated RTU Control Systems.

- i. The replacement RTUs support IEC 60870-5-101/104 communication protocols and meet all interface and performance requirements of the existing design at Arnot Power Station.
 - j. The RTU Control Systems are time-synchronised by the National Control Centre in accordance with the applicable *Employer* and IEC standards.
3. The *Contractor* ensures that the AGC RTU Control System, as implemented through the replacement RTU, complies with the South African Grid Code – Information Exchange Code (latest approved version at the Contract Date). The AGC RTU Control System and its interfaces meet all functional and communication requirements of the Code, including data acquisition, communication protocols, and signal exchange with National Control. Compliance with these requirements is demonstrated and verified during Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), and commissioning.

3.2.4. Availability, Maintainability and Equipment Life Cycle

3.2.4.1. Availability

1. The *Contractor* designs the replacement RTUs to achieve safe and reliable operation within the existing RTU Control Systems, thereby reducing the risk of control system failure and consequent loss of production. Each replacement RTU is designed to ensure that the associated RTU Control System achieves an availability of greater than 99.99%, measured as annual uptime excluding *Employer* approved outages.
2. To achieve the required availability, the *Contractor* fabricates, assembles, and finishes the replacement RTUs in accordance with applicable international and industry quality-control standards, including ISO 9001 or equivalent. The *Contractor* applies the OEM's fully proven standard designs practicable, avoiding unnecessary customisation unless required by this *Works Information*.
3. The *Contractor* includes all software updates, upgrades, patches, and firmware revisions required for planned and unplanned maintenance in the availability calculations. Each replacement RTU is designed to support online maintenance, including replacement or upgrade of hardware modules, without loss of system availability.

3.2.4.2. Maintainability

1. The *Contractor* provides complete documentation to support the operation, maintenance, and repair of the RTU Control Systems as affected by the replacement RTUs. The documentation includes user manuals, preventive maintenance procedures, troubleshooting guides, spare parts catalogues, and as-built drawings, in both hard copy and electronic format.

2. The *Contractor* designs the replacement RTUs to allow preventive maintenance activities to be performed without the need to de-energise associated control circuits. The design incorporates a modular architecture, including hot-swappable or easily replaceable modules, to facilitate safe and efficient maintenance in accordance with the Employer's operational and safety standards.

3.2.4.3. Equipment Life Cycle

1. The *Contractor* provides a replacement RTU with a minimum life cycle of 15 years from the date of *Completion*.
2. If the replacement RTU OEM ceases to support or discontinues support for any sub-assemblies during the equipment life cycle, the *Contractor* makes available to the *Employer*, at no additional cost, the manufacturing designs, technical drawings and rights necessary for the manufacture or replacement of such sub-assemblies.

3.2.5. Changeover Implementation Methodology

1. The *Contractor* designs and implements the changeover of the replacement AGC RTU, Generator Plant A RTU, and Generator Plant B RTU to maintain safe and continuous operation of the RTU Control Systems, minimise downtime, and prevent any impact on generation or plant operations.
2. The *Contractor* prepares a detailed changeover implementation plan covering design, installation, commissioning and testing. The *Contractor* submits a draft plan to the *Project Manager* no later than three (3) months before the planned start of commissioning, and a final plan at least 21 days before commissioning. The *Contractor* proceeds with changeover only after the *Project Manager* accepts the plan.
3. The *Contractor* plans and executes the changeover with careful preparation, recognising the criticality of the AGC RTU and Generator Plant RTUs to Unit operation and control. The *Contractor* ensures that plant operations are maintained, downtime is minimised, and the production process is not adversely affected during changeover.
4. The default method of implementing the *Works* is by online changeover, ensuring continuous operation of the RTU Control Systems without production interruption. Where a plant outage is considered unavoidable, the *Contractor* identifies such outages at the tender stage and includes them in the proposed changeover plan. Any required outage is subject to prior acceptance by the *Project Manager*. Outages not declared at tender stage are deemed to be at the *Contractor's* risk and cost.
5. The *Contractor* achieves and maintains high plant availability, reliability and safety throughout the installation, commissioning and changeover process.

6. The *Contractor* integrates all stakeholders of the *Employer* in preparing a single integrated changeover implementation plan. The *Contractor* submits the plan to the *Project Manager* for acceptance. The plan includes, as a minimum:

a. Implementation strategy

- i. The *Contractor* prepares a detailed and coordinated implementation strategy.
- ii. The strategy for field implementation covers field wiring, marshalling and trunk cabling concepts, and identifies all pre-outage installation work.
- iii. The *Contractor* performs the changeover on a per-module basis, replacing each RTU module sequentially while maintaining continuous operation of the associated RTU Control Systems. During each phased replacement, the Contractor ensures that control and monitoring of all Units remain operational, with only minimal loss of functionality and no adverse impact on plant performance.
- iv. The strategy for BME, DCS and Hitachi Energy MicroSCADA.
- v. The strategy for equipment downtime describes requirements, risks, and available implementation options.

b. Planning

- i. The *Contractor* develops and submits a complete RTU Modernisation Plan for acceptance. The plan includes, as a minimum, the changeover strategy, detailed designs for the replacement RTUs, and identification of all operational or technical constraints. The Contractor performs all RTU changeovers online, maintaining continuous operation of the RTU Control Systems during each phase. Where a plant outage is unavoidable, the Contractor identifies it at the tender stage, includes it in the RTU Modernisation Plan, and obtains acceptance from the *Project Manager* before implementation.
- ii. The *Contractor* develops and submits a complete RTU modernisation plan. The plan includes, as a minimum, the changeover strategy, detailed replacement RTU designs and identified constraints. The *Contractor* carries out all RTU changeovers online, maintaining continuous plant operation during each phase. If an outage is required, the Contractor identifies it at tender stage, includes it in the modernisation plan, and obtains acceptance from the *Project Manager* before execution.

- iii. The *Contractor* incorporates the *Employer's* operational and management requirements into the modernisation plan and demonstrates in the plan how these requirements are met.

c. Changeover

- i. The *Contractor* performs the changeover of the replacement RTUs by installing pre-configured and pre-wired units online and transferring control and monitoring functions from the existing RTUs. The *Contractor* installs all necessary hardware and software interfaces between the replacement RTUs and the field devices, the Unit DCS, the Hitachi Energy MicroSCADA, and National Control. The *Contractor* conducts all related commissioning activities and Site Acceptance Tests (SAT) in the presence of the *Supervisor* and obtains acceptance from the *Project Manager* before the changeover is deemed complete. The *Contractor* maintains continuous operation of the RTU Control Systems throughout the changeover, with only minimal loss of functionality.
- ii. The *Contractor* compiles commissioning procedures and gives particular attention to the changeover process to ensure it is carried out safely, without plant damage or production losses.
- iii. The *Contractor* submits the changeover procedure to the *Project Manager* for acceptance not later than 21 days before the start of commissioning. The procedure includes contingency steps, timeframes, and associated risks for restoring plant operation if the changeover fails. The AGC RTU is common to all six Units and its changeover is not linked to Unit outages.
- iv. The *Contractor* changes over the AGC RTU so that National Control experiences only a temporary loss of visibility per I/O module.
- v. The *Contractor* runs the replacement AGC RTU in parallel with the existing *Employer's* AGC RTU before and during changeover.
- vi. The *Contractor* provides for reversion to the existing *Employer's* AGC RTU within the allocated commissioning time if the changeover is not successful or faults occur requiring resolution by the *Contractor*.
- vii. During changeover planning, the *Contractor* determines the best changeover path, shows how the time allocation for each RTU is met, and submits the changeover package to the *Project Manager* for acceptance in consultation with the *Supervisor*

- viii. The *Contractor* identifies and mitigates impacts on the Hitachi Energy MicroSCADA servers, HMIs, and other plant areas outside the changeover scope but affected by the *Works* and includes these in the changeover plan submitted to the *Project Manager*.
- ix. For intervals between phased RTU changeovers, the *Contractor* provides all necessary temporary hardwired and networked interfaces to maintain plant control and monitoring.
- x. For intervals between phased RTU changeovers, the *Contractor* provides all necessary temporary power supply cables, circuit breakers, and related temporary works to allow a smooth changeover.
- xi. The *Contractor* confirms final arrangements with the *Project Manager* not later than 72 hours before the start of each commissioning and Site Acceptance Test period.

3.2.5.1. AGC Changeover Strategy

The *Contractor* provides an online changeover for the RTU control system as follows:

1. The *Contractor* operates the replacement AGC RTU in parallel with the existing AGC RTU before and during changeover.
2. The *Contractor* reuses all cables from the IDF to the three RTU control system cubicles.
3. The *Contractor* reuses all four RTU control system cubicles for the duration of the *Works*. Where reuse is reasonably not possible, the *Contractor* identifies this at tender stage, provides justification, and includes the cost of replacement cubicles in the tender submission. Any replacement not identified at tender stage is at the *Contractor's* risk and cost.
4. The *Contractor* reuses the installed Krone termination blocks in the RTU control system cubicles. Where reuse is reasonably not possible, the *Contractor* identifies this at tender stage, provides justification, and includes the cost of replacement termination blocks in the tender submission. Any replacement not identified at tender stage is at the *Contractor's* risk and cost.
5. The *Contractor* installs the replacement AGC RTU and its input/output modules in the space provided at the bottom of the AGC RTU cubicle, as specified by the *Supervisor*. Where this is not reasonably possible, the *Contractor* declares this at tender stage and proposes a reasonable alternative solution, with justification and pricing, in the tender submission. Any deviation not declared at tender stage is at the *Contractor's* risk and cost.

6. The *Contractor* supplies, installs, and terminates a temporary 220 V power supply cable from the 7-in-1 Control Room to the IDF Room to power the RTUs during changeover. The *Contractor* removes all temporary *Works* at *Completion* at his own cost.
7. The *Contractor* connects the AGC RTU control system to National Control in parallel with the *Employer's* existing AGC RTU control system as follows:
 - a. The *Contractor* powers the replacement AGC RTU using the temporary power cables pulled from the Control Room and supplied by the *Contractor* as specified in Section 3.2.7.2.
 - b. The *Contractor* connects the replacement AGC RTU to the BME at the HV Yard using spare cores of the existing fibre optic cable that currently connects the *Employer's* AGC RTU to the BME. Where the existing fibre optic cable cannot be reused, the *Contractor* provides and installs new fibre optic cables as part of the *Works*. The requirement for new fibre optic cables is identified and costed by the *Contractor* at the tender stage and included in the *Contractor's* Proposal.
 - c. The *Contractor* terminates the spare cores of the fibre cable in (b) on a port on the BME provided by the *Employer*, or by multi-dropping on the TEMSE port, so that both the old and new AGC RTUs operate online temporarily during changeover. Where the reuse of spare cores or ports is not reasonably possible, the *Contractor* declares this at tender stage and proposes a reasonable alternative solution. Any undeclared deviations are at the *Contractor's* risk and cost.
8. The *Contractor* connects, integrates and commissions the interface between the replacement AGC RTU and the Hitachi Energy MicroSCADA, ensuring full functionality, data exchange and control compatibility in accordance with the existing system design and communication protocols.
9. The *Contractor* conducts the Site Acceptance Test (SAT) for the AGC RTU Control System, demonstrates successful completion of all test cases in the presence of the *Supervisor*, and submits the signed commissioning and SAT documentation to the *Project Manager* for acceptance.
10. The *Contractor* simulates and verifies, using *Contractor*-supplied calibrated *Equipment*, that all required signal exchanges perform in accordance with the *Works Information*. The *Contractor* carries out these tests in the presence of the *Supervisor*, who witnesses and confirms the responses and results. The following signal exchanges are verified as a minimum:
 - a. All field signals from the IDF to the replacement AGC RTU.

- b. All signals from the replacement AGC RTU to the ABB P14 DCS.
 - c. All signals from the replacement AGC RTU to National Control.
 - d. All signals from the replacement AGC RTU to the Hitachi Energy MicroSCADA.
 - e. All signals exchanged between the Generator Plant A and Generator Plant B RTU Control Systems and the AGC RTU Control System.
11. The *Contractor* simulates and verifies, using *Contractor*-supplied test *Equipment*, that the following signal exchanges perform as required, with responses confirmed by the *Supervisor*:
- a. All field signals from the IDF to the AGC RTU.
 - b. All signals from the AGC RTU to the ABB P14 DCS.
 - c. All signals from the AGC RTU to National Control.
 - d. All signals from the AGC RTU to the Hitachi Energy MicroSCADA.
 - e. All signals between the Generator Plant A and Generator Plant B RTU control systems and the AGC RTU control system.
12. The *Contractor* demonstrates the successful completion of all tests as evidence that the replacement RTUs operate fully in accordance with the functionality and philosophy of the existing *Employer's* RTU Control Systems. The *Contractor* compiles and submits the complete commissioning and test documentation to the *Project Manager* for acceptance.
13. Any non-conformance or deviation identified during testing is corrected by the *Contractor* at no additional cost to the *Employer*.
14. The *Contractor* performs the actual changeover from the existing *Employer's* AGC RTU to the replacement AGC RTU provided under this contract as follows:
- a. The *Contractor* executes the changeover on a per I/O module basis to maintain plant control and minimise downtime.
 - b. The *Contractor* disconnects the first I/O module from the existing *Employer's* AGC RTU. Using the krone block corresponding to the module that has been disconnected, the *Contractor* connects the signals related to this module on the other side of the Krone block and connect these signals to the replacement RTU provided by the *Contractor* as part of the *Works*.
 - c. The *Contractor* performs a functional test, in the presence of the *Supervisor*, to verify that the signals of each relevant I/O module have been successfully migrated and are fully operational within the AGC RTU Control System incorporating the replacement RTU

supplied by the *Contractor*. The *Contractor* records the results of each test and submits the signed test documentation to the *Project Manager* for acceptance.

- d. If the *Supervisor* accepts the functional test results for that module, the *Contractor* repeats the procedure for the next I/O module, continuing until all signals of the existing *Employer's* AGC RTU have been fully migrated to the replacement AGC RTU.
 - e. If the migration of signals from any I/O module is unsuccessful, the *Contractor* immediately reverts to the existing AGC RTU within the agreed time allocation, resolves the issue, and reattempts the migration until all signals are successfully migrated and demonstrated to the *Supervisor*.
 - f. The *Contractor* provides all necessary test *Equipment*, tools and resources to perform the above *Works*, and includes contingency provisions and maximum allowable reversion timeframes in the accepted changeover plan.
15. At the successful completion of the AGC RTU changeover, as demonstrated in accordance with the accepted changeover procedure and witnessed by the *Supervisor*, the *Contractor* compiles and submits the signed commissioning and Site Acceptance Test documentation to the *Project Manager* for acceptance.
 16. The *Contractor* decommissions, removes, stores, and packages the existing *Employer's* AGC RTU and I/O modules, and hands them to the *Project Manager* through a formal document transmittal. Custody transfers upon acceptance by the *Project Manager*.
 17. The *Contractor* relocates the CPU, I/O modules, and the patch panel from the Main RTU cubicle to the designated top section of the AGC RTU cubicle, ensuring all relocated components are fully functional and that wiring integrity and performance are maintained.
 18. The *Contractor* ensures that the Main RTU cubicle is cleared, made safe, and made available for the installation of the Generator Plant RTUs.
 19. The *Contractor* installs the Generator Plant RTUs and associated modules in the Main RTU cubicle in accordance with the accepted design.
 20. The *Contractor* applies the same changeover methodology, testing, and documentation process used for the AGC RTU control system to the Generator Plant RTU control systems.
 21. At *Completion* of the changeover of the Generator Plant RTUs, the *Contractor* decommissions, removes, and packages the existing *Employer's* RTUs and hands them to the *Project Manager* through a formal transmittal for the *Employer's* use.
 22. The *Contractor* connects all replacement RTUs that form part of the *Works* to the *Employer's* permanent power supply circuit breakers previously used by the existing *Employer's* AGC,

Generator Plant A, and Generator Plant B RTUs, and verifies that loading does not exceed 80% of rated capacity.

3.2.6. C&I SPECIFICATION OF THE WORKS

1. The *Contractor* designs, procures, and supplies replacement RTUs for the AGC, Generator Plant A, and Generator Plant B. Each new RTU is fully redundant and operates independently, ensuring continuity of the existing RTU control systems in the event of individual RTU failure.
2. The *Contractor* ensures that each replacement RTU is fully compatible with the existing RTU control system architecture. The *Contractor* integrates the new RTUs with the *Employer's* existing interfaces, including the Hitachi Energy MicroSCADA, ABB P14 Unit DCS, the BME, National Control, and all other connected plant systems, such that the RTU control systems continue to function as they currently operate.
3. The *Works* are divided into the following parts:
 - a. Decommissioning of the existing *Employer's* AGC, Generator Plant A, and Generator Plant B RTUs, including removal of obsolete equipment and components.
 - b. Design, engineering, manufacture, inspection, and testing at the manufacturer's works, supply, packing, delivery to *Site*, unloading, storage, in-plant transportation, erection, supervision, pre-commissioning, commissioning, and performance testing of the replacement RTUs. This includes all RTU hardware, I/O modules, marshalling, cabling, and accessories necessary for integration with the existing RTU control systems.
4. The *Contractor* carries out all hardware and software engineering necessary to integrate the new RTUs into the existing RTU control systems. This includes configuration of interfaces to the Hitachi Energy MicroSCADA, ABB P14 Unit DCS, the BME for National Control, and all existing archiving and monitoring functions.
5. The replacement RTUs maintain the following existing functions, as monitored on the Hitachi Energy MicroSCADA and, for AGC, the ABB P14 DCS:
 - a. Interface to National Control centre
 - b. Interface to Standby National Control centre
 - c. Interface to Hitachi Energy MicroSCADA
 - d. Interface to the Unit ABB P14 DCS
6. The *Contractor* integrates all technical schedules, wiring diagrams, and engineering documents, and proposes a complete solution for replacement of the RTUs to ensure that

the RTU control systems remain fully functional and compatible with the *Employer's* existing systems.

3.2.6.1. Design of Control System Equipment

1. The *Contractor* designs, engineers, configures, commissions and tests the replacement RTUs and associated equipment forming part of the *Works*, including all required hardware and software, to ensure compatibility with and full functionality of the existing RTU control systems.
2. The *Contractor* provides all *Equipment*, services and executes all work in accordance with this *Works Information*.
3. The *Contractor* is responsible for all system interfaces and modifications necessary to integrate the replacement RTUs with the existing *Employer's* systems, including the Hitachi Energy MicroSCADA, ABB P14 DCS, National Control (BME and standby), and any other external interfaces forming part of the *Works*.
4. The *Contractor* implements the replacement RTUs in a consistent and integrated manner so that the RTU control systems remain fully operational and functionally equivalent to the existing systems.
5. The *Contractor* provides redundancy in accordance with the requirements defined in this *Works Information*, including dual CPUs, dual communications cards, redundant power supplies, and redundant communication paths. The design minimises the impact of equipment failure on the overall plant operation.
6. The *Contractor* supplies engineering documents in accordance with the VDSS in Appendix 1, and updates as-built drawings and records after completion of the *Works*.
7. The design applies to both hardware and software engineering functions necessary to meet the operational and functional requirements of the AGC, Generator Plant A, and Generator Plant B RTU control systems.

3.2.6.2. Backups and Licencing

1. The *Contractor* provides the *Employer* with all backup files, configuration files, application software, firmware, parameter settings, and associated documentation of the *replacement* RTUs in editable, non-proprietary, and unencrypted format. These are delivered as part of the *Works* to enable the *Employer's* personnel to carry out future changes and modifications on *Site*.
2. The *Contractor* installs and verifies all relevant software on the *Employer's* designated maintenance computers as directed by the *Project Manager*.

3. The *Employer* pays for all software licences required for the RTU Control Systems on a once-off basis. The *Contractor* ensures that all licences associated with the replacement RTUs are perpetual, non-expiring, and transferable for the full operational life of the equipment, without any requirement for renewal or additional licensing fees.
4. No further license fees shall be payable by the *Employer* for the life span of the equipment. The *Contractor* provides, at no additional cost, all OEM-issued software updates, upgrades, and security patches released during the life span of the equipment and assists the *Employer* in applying these as part of the ongoing support obligations.

3.2.6.3. BME at the HV Yard

1. The *Contractor* is responsible for all configurations, parameterisation, and required modifications to the BME located in the HV Yard equipment room to enable reliable and continuous communication between the replacement AGC RTU and National Control. All configuration changes are carried out in coordination with Eskom Telecommunications and are subject to acceptance by the *Project Manager*.
2. These activities form part of the *Contractor's* scope of work and include all communication paths, routing, bandwidth allocation, and redundancy settings necessary for a fully functional system.
3. The *Contractor* demonstrates, through commissioning and Site Acceptance Tests (SAT), that the configured BME enables seamless and reliable communication between the replacement AGC RTU, National Control, the Standby National Control Centre, and the *Employer's* Hitachi Energy MicroSCADA systems. Verification is performed in accordance with the Generation AGC Design Standard for Power Plants (240-119416400) and the South African Grid Code – Information Exchange Code.

3.2.6.4. Field Equipment and Cabling Requirements

1. Replacement of existing instrument and trunk cabling is excluded from the scope of this *Works Information*.
2. The *Contractor* reuses all existing field cabling from the plant to the IDF.
3. The *Contractor* reuses all cables from the IDF to the AGC RTU, Generator Plant A RTU, and Generator Plant B RTU.
4. The *Contractor* reuses the existing cables from the IDF to the marshalling panels.
5. The *Contractor* disconnects all existing cabling from the *Employer's* RTUs and re-terminates it onto the replacement RTUs, ensuring correct identification, labelling, and continuity of all connections in accordance with the *Works Information* and approved termination drawings.

6. Any additional cabling required to integrate the replacement RTUs and their associated I/O modules into the existing RTU Control Systems forms part of the *Contractor's* scope. Such cabling is supplied, installed, terminated, tested, and commissioned by the Contractor at no additional cost to the *Employer*.
7. Where existing cables cannot be reasonably reused, the *Contractor* identifies this at tender stage, declares the requirement, and includes a proposed replacement solution with associated costs in the tender submission.
8. The *Contractor* ensures that the baseline RTU control system remains fully interfaced to the proposed equipment. The *Contractor* provides all signal interface protection where multiple subsystems are connected.
9. The interface between the replacement AGC RTU and the existing ABB P14 Unit DCS remains hardwired in accordance with the *Employer's* design and existing signal configuration.
10. The *Contractor* designs the replacement RTUs to be fully compatible with the existing BME system at the HV Yard and reuses the existing fibre optic cables and patch panels between the HV Yard and the IDF Room, in accordance with the *Employer's* design and the *Works Information*.
11. Where reuse of the existing fibre optic cables is not technically feasible, the *Contractor* identifies this at tender stage and includes the provision of new fibre optic cables in the tendered scope and price. The *Contractor* supplies, installs, terminates, tests, and commissions any new fibre optic cables as part of the *works*, at no additional cost to the *Employer*.
12. Where new fibre optic cables or patch panels are required, the *Contractor* designs, supplies, installs, commissions, and tests these at no additional cost to the *Employer* and declares such requirements at tender stage.
13. The Contractor ensures that all cables are securely mounted on process control racks, and that all disturbed or damaged fire seals are replaced or repaired to *Site* standards.
14. Where core drilling is required for the installation of new cubicles, the *Contractor* ensures compliance with *Site* standards, regulations, and procedures.
15. Any plant modifications required to complete the *works* are immediately notified in writing to the *Project Manager* and executed only upon acceptance.
16. Scaffolding will be made available to the *Contractor* upon request. This request to be brought to the attention of the *Supervisor* a week prior to use thereof.
17. All field equipment is installed with regard for the following:
 - a. Passageways and the movement of people and equipment during maintenance activities

- b. Ergonomics and maintenance access to the equipment

3.2.6.4.1. Field Instrumentation

1. Replacement of field instrumentation is not part of the scope of this project.

3.2.6.4.2. C&I and Power Cabling

1. All cabling and cable racking forming part of the *Contractor's* scope complies with Eskom Standard 240-56227443: Requirements for Control and Power Cables for Power Stations.
2. The *Contractor* installs all cabling with adequate protection against mechanical damage, heat, chemicals, dust accumulation, and electromagnetic interference (EMI), in accordance with *Site* conditions.
3. For the purpose of this *Works Information*:
 - a. Instrument cabling means cabling between field instruments and junction boxes or marshalling panels.
 - b. Power supply cabling means cabling required to supply field equipment, control modules, servers, and HMI screens.
4. Instrument cables are routed separately from electrical power cables. Where crossovers are unavoidable, they are made at right angles.
5. The *Contractor* designs routes for power and signal cabling, including associated racking and containment systems, to ensure consistency, adequate physical separation of redundant paths, and resilience against common-mode failures. The design aligns with the redundancy and segregation principles of the existing RTU Control System and complies with the *Employer's* standards for cable routing and installation.
6. The *Contractor* provides not less than 20% spare installed and terminated cores in all new multi-core cables, rounded up.
7. The *Contractor* provides and installs cable numbering for all newly installed cables. Cable numbers correspond with equipment KKS numbers and are reflected on all drawings and in the as-built cabling register.
8. Where existing cables cannot be reasonably reused, or where new cables are required for the integration of the replacement RTUs into the existing RTU control systems, the *Contractor* declares this at tender stage and provides the necessary cabling, terminations, and testing as part of the *Works*.

9. The *Contractor* ensures all disturbed fire seals are repaired or replaced in accordance with *Site* fire protection standards.

3.2.6.4.3. Spare Capacity in Enclosures, Trunking, Conduits, and Racking

1. All new trunking, junction boxes, enclosures and racking provided under the Contract are designed and installed with not less than 20% spare usable capacity after installation, rounded up to the nearest practicable size.
2. All new conduits provided under the Contract are designed and installed with not less than 50% spare usable capacity after installation, rounded up to the nearest practicable size.
3. The *Contractor* submits as-built documentation, including annotated drawings and photographs, demonstrating the spare capacity in all enclosures, trunking, conduits, and racking at *Completion*.

3.2.6.5. Power Supply Requirements

3.2.6.5.1. General Power Supply Requirements

1. The existing RTUs are powered from redundant 220 V AC power supplies. These power supplies source directly from a DB located adjacent to the RTUs in the IDF Room. The DB receives power from the Units' UPS located in EDS 123 and EDS 456. The *Contractor* supplies replacement RTUs that are fully compatible with, and capable of operating from, the existing redundant 220 V AC power supplies provided at the IDF Room. Where required, the *Contractor* designs and installs appropriate protective devices on the DB to ensure safe and reliable operation of the replacement RTUs in accordance with the *Employer's* standards and *Works Information*.
2. The *Contractor* provides the cables, circuit breakers and all other *Equipment* necessary to connect the replacement RTUs to the distribution boards at the IDF Room.
3. The *Contractor* provides all power supply requirements as required for the RTU replacement design during the tendering stage. This includes power supply for all replacement RTU components and devices, forming part of the RTU control system.
4. The *Contractor* confirms in writing during the tendering stage that his system is compatible to the power supplies provided by the *Employer*.
5. A high level of reliability of the power distribution system forms the basis of the design for all hardware components by the *Contractor*. No single point of failure shall affect the performance and reliability of the RTU control system and shall not affect the performance of the Unit. Therefore, the detailed design by the *Contractor* considers sufficient power supply

- segregation to maintain supply availability to the replacement RTU, its components and devices.
6. The *Contractor* designs the replacement RTU power distribution in a redundant manner, fed from UPS supply for AC systems.
 7. The *Contractor* supplies the power distribution circuits by appropriately sized circuit breakers, giving thought and rationale to power supply distribution, segregation and diversity.
 8. The *Contractor* is responsible for the supply of all power supply loading requirements, providing detailed load calculations, distribution panel circuit breaker sizing and power calculations for both AC and DC systems forming part of the replacement RTUs.
 9. As a minimum, the following forms part of the *Contractor's* power distribution design:
 - a. Size type and response of protection devices used within the AC and DC power circuits.
 - b. Distribution cable sizing.
 - c. Circuit breaker sized appropriately (i.e. consideration for in rush currents on system start-up).
 - d. Short circuit and overload conditions and protection.
 - e. Earthing, Lightning, and electrical protection.
 10. The *Contractor* uses redundant power supplies for the replacement RTU, where redundant supplies are fed from the redundantly configured UPS supplies for AC systems.
 11. The *Contractor* powers networked components (such as switches forming part of the RTU control systems) from redundant supplies.
 12. The *Contractor* configures networked components for the monitoring of equipment health, where the alarms generated by the hardware proxy of the equipment are either alarmed via the network, or by configuring a hardware contact alarm of the equipment (common alarm).

3.2.6.5.2. Earthing, Lightning and Electrical Protection

1. The *Contractor* designs and implements a complete earthing and lightning protection scheme for all replacement RTUs, including I/O modules, marshalling panels, patch panels, network equipment, and associated power supplies, to ensure safe and reliable operation.
2. The *Contractor* submits the proposed earthing concept, including drawings, calculations, and connection details, to the *Project Manager* for review and acceptance prior to installation.
3. The earthing design complies, as a minimum, with:
 - a. OEM best practices,

- b. Eskom Standard 240-56356396 “Earthing and Lightning Protection Standard”, and
 - c. Applicable IEC/IEEE EMC and earthing standards for power plants (e.g., IEC 61000 series, IEEE 80).
4. During tendering, the *Contractor* declares whether existing earthing points, busbars and earthing infrastructure are adequate. If additional earthing or lightning protection measures are required, the *Contractor* includes these in the tendered solution and prices accordingly.
 5. Upon completion of the C&I and Electrical installation, the *Contractor* conducts earthing system integrity tests, including but not limited to:
 - a. Earth resistance measurement,
 - b. Earth continuity checks, and
 - c. Bonding/loop impedance tests.
 6. These tests are performed in the presence of the *Supervisor*, and results are submitted to the *Project Manager* for acceptance.
 7. The *Contractor* ensures that all equipment supplied under this Contract is immune to electromagnetic interference (EMI), meeting internationally accepted EMC standards for power plants.

3.2.6.6. RTU Interfaces

3.2.6.6.1. Interface to Hitachi Energy MicroSCADA

1. The Hitachi Energy MicroSCADA system provides centralised monitoring and control of the Station Electrical Reticulation, including the 275 kV Switchyard, the 400 kV Switchyard, associated switchgear, auxiliaries and Outside Plant equipment. The existing RTU control systems provide the required interfaces for control and monitoring of the AGC RTU and perform data acquisition through the Generator Plant A RTU and Generator Plant B RTU for the Station Electrical Reticulation.
2. The *Contractor* provides a networked interface for communication, control and monitoring of the AGC, Generator Plant A and the Generator Plant B RTU control systems functions to create a seamless, and fully functional and operational RTU installation.
3. The functions included in the *Contractor’s* scope include, but are not limited to, the following:
 - a. Configuring all control and monitoring signals in accordance with the existing *Employer’s* RTU control system database (Appendix 2), ensuring seamless use of these signals within the Hitachi Energy MicroSCADA for control, monitoring, and archiving of process variables.

- b. Preserving the existing control and operational philosophy of the RTU control systems and ensuring that the replacement RTUs and their I/O modules are fully compatible with and integrate seamlessly into the existing Hitachi Energy MicroSCADA environment.
- c. Providing all necessary *Equipment*, design, and engineering to ensure that the replacement RTUs and their interfaces remain compatible and operable with the Hitachi Energy MicroSCADA, including the provision of legacy and/or new communication protocols required by the existing RTU control systems solution.
- d. Ensuring that all operator and Human–Machine Interface (HMI) functions currently provided by the existing RTU control systems are maintained without reduction or alteration and are fully supported by the replacement RTUs.

3.2.6.6.2. Interface to ABB P14 DCS

1. The AGC RTU has a hardwired interface to the ABB P14 DCS.
2. This interface is to be kept as is. No modifications are expected on the existing hardwired interface or on any software configurations of the DCS.
3. Should the *Contractor* determine that modifications to the hardwired interface, including any software configurations on the DCS, are required to provide a fully functional replacement RTU within the existing AGC RTU control system, the Contractor shall be fully responsible for arranging and funding such modifications. This includes subcontracting ABB South Africa (Pty) Ltd or an *Employer*-approved ABB subcontractor to carry out the *Works*. The *Contractor* must clearly indicate during the tender stage any such modifications it foresees as necessary to achieve a fully functional RTU replacement solution.

3.2.6.6.3. Interface to National Control

1. The AGC RTU interfaces with National Control and Standby National Control via the BME located at the HV Yard, using the IEC 60870-5-101 (IEC 101) protocol.
2. The *Contractor* uses the existing communication infrastructure to connect the replacement AGC RTU to the National Control Centre and Standby National Control Centre through the BME. The *Contractor* verifies the integrity and functionality of all existing connections and configurations during installation and commissioning to ensure reliable and uninterrupted communication with National Control.
3. In accordance with the changeover requirements stipulated in Section 3.2.5, the *Contractor* may be required to establish a temporary interface to enable a smooth and continuous changeover. Where such a temporary interface is required, the *Contractor* provides all

necessary *Equipment*, including hardware, software configurations, and integration at the BME.

4. The *Contractor* identifies and prices all hardware, software, and configuration requirements for the interface between the replacement AGC RTU and National Control during the tender stage. These requirements include all components, terminations, and communication configurations necessary to provide a fully functional and reliable interface in accordance with this *Works Information*.

3.2.6.7. Time Synchronization

1. The RTU control systems are time-synchronised by the National Control Centre. Accurate time stamping of all I/O variables shall be performed within the replacement RTU, and these timestamps shall be used for control processing, event logging, and archiving functions. The replacement RTU ensures chronological ordering of all processed data.
2. The synchronisation link to the time server is provided at station level using the Network Time Protocol (NTP).
3. The *Contractor* designs and configures the replacement RTU time synchronisation link to minimise latency and ensures that the RTU control systems are synchronised to the station time server with an accuracy of ± 1 ms.
4. The replacement RTUs perform event time stamping with a resolution of 1 ms, ensuring precise alignment with National Control requirements.
5. The *Contractor* designs and configures the replacement AGC RTU to achieve a maximum turnaround time of 4 ms between the National Control Centre and the AGC RTU, in compliance with AGC certification requirements.

3.2.6.8. Testing and Commissioning Requirements

1. As a minimum, the *Contractor* complies with the requirements of IEC 62381 (Automation Systems in the Process Industry – FAT, SAT, and SIT).
2. The *Contractor* is responsible for the correct configuration, design, and performance of the replacement RTU and its integration within the existing RTU control system. All activities are carried out in accordance with the quality assurance procedures established for this project.
3. All replacement RTU components, subsystems, and interfaces forming part of the *works* are inspected, tested, and commissioned by the *Contractor*.
4. All calibration *Equipment* used for testing and calibration is accredited. The accuracy of this *Equipment* shall be higher than that of the equipment under calibration. The *Contractor*

- provides accreditation certificates or equivalent proof of compliance to the *Employer* upon request.
5. The *Contractor* submits detailed procedures for all functional and performance tests, including clear acceptance criteria for all monitored parameters, for acceptance by the *Project Manager* not less than six (6) weeks before the first scheduled tests.
 6. Prior to delivery to *Site*, the *Contractor* conducts a Factory Acceptance Test on the replacement RTU hardware, firmware, and software at the *Contractor's* premises. The FAT is witnessed by the *Employer's* representatives, and the *Contractor* provides at least one weeks' notice of the FAT. The FAT includes, as a minimum:
 - a. Verification of compliance with the design and functional requirements of the *works*.
 - b. Testing of all defined I/O signals and simulation of representative field conditions.
 - c. Demonstration of communication protocols including full verification of IEC 60870-5-101/104 protocol implementation.
 7. Following installation on *Site*, the *Contractor* conducts a SAT to demonstrate the correct operation of the RTU within the RTU control system. The SAT includes integration with all required interfaces (ABB P14 DCS, MicroSCADA, BME, and National Control).
 8. The *Contractor* ensures that downtime of the RTU control systems during changeover is minimised by implementing precautionary measures and providing detailed risk assessments, including mitigations, for acceptance by the *Employer's* representative.
 9. Functionality of the AGC RTU control system is tested, confirmed, and formally accepted by National Control in accordance with the following Eskom procedures (available on request):
 - a. TEMSE IEC 60870-5-101 Implementation.
 - b. TEMSE AGC Functional Description.
 10. As a pre-requirement, the *Contractor* performs compatibility and communication tests with National Control to prove that the replacement RTU solution adheres to the 32-bit string code requirements and the specified communication response times. If prior type-testing and approval from National Control has already been granted, the *Contractor* may submit proof of this approval as part of the tender enquiry.
 11. The *Employer's* representatives are responsible for coordinating liaison with National Control for such tests. The *Contractor* provides all *Equipment*, resources, and technical support necessary to conduct the tests successfully.

3.2.6.9. Decommissioning, removal and disposal of the existing RTU

1. The *Contractor* decommissions, removes, and hands over all modules and power supply units from the existing *Employer's* AGC RTU to the *Project Manager* for use as spares on other AGC RTU installations. All removed modules are packaged in anti-static material and boxed adequately to prevent damage. A detailed inventory list of the handed-over equipment is prepared by the *Contractor* and submitted to the *Project Manager* for acceptance.
2. Where disposal of decommissioned equipment is necessary, the *Contractor* disposes of all waste in full compliance with the Eskom Waste Management Standard (32-245).
3. Where it is necessary to establish temporary configurations during the changeover from the existing *Employer's* RTU to the replacement RTU (to meet the requirements of Section 3.2.5), the *Contractor* provides all necessary temporary equipment and facilities to ensure a smooth and safe transition. This includes, but is not limited to, temporary cubicles, cables, patching arrangements, and power supplies. The *Contractor* ensures that such temporary solutions are fully documented, controlled, and removed once the permanent configuration is successfully commissioned and accepted.

3.2.7. ELECTRICAL SPECIFICATION OF THE WORKS

3.2.7.1. GENERAL

1. For all electrical *Works*, the *Contractor*:
 - a. Provides comprehensive training for Engineering, Maintenance, and Operating personnel covering design, installation, commissioning, operation, and maintenance of the replacement RTUs.
 - b. Ensures that all *Works* are implemented in full compliance with the applicable standards and specifications listed within this document.
 - c. Provides, installs, and terminates all power supply cabling from the distribution boards to the replacement RTUs, ensuring correct sizing, protection, and routing.
 - d. Takes full responsibility for supplying, installing, terminating, and testing any additional cabling required for the complete replacement and integration of the replacement RTUs within the existing RTU control systems.

3.2.7.2. TEMPORARY WORKS

1. The *Contractor* installs an MCB in the Unit 3 MMI DB (30UCA30GF001) located in the Unit 3 control desk. A double-core cable of approximately 300 m in length is provided and pulled by the *Contractor* from 30UCA30GF001 in the Control Room to the AGC or Generator RTU

cubicles in the IDF Room. The temporary supply is connected to the RTUs, which have dual power supply input ports.

2. Upon successful completion of the RTU changeover, the *Contractor* removes the temporary power cable between Unit 3 MMI DB 30UCA30GF001 and the AGC/Generator RTU cubicles. The removed cable is handed over to the *Supervisor* for reuse or storage.

3.2.7.3. UPS'S AND BATTERIES

1. The *Employer* provides the UPS, batteries, and DBs for the permanent supply of power to the replacement RTUs.
2. The *Contractor* installs the required circuit breakers, sizes and procures the cables from the DBs to the replacement RTUs, and performs installation, termination, and testing to ensure fully functional replacement RTUs as per the requirements of this *Works Information*.

3.2.7.4. ELECTRICAL POWER CABLING

For the electrical power cabling, the *Contractor* meets the followings requirements as a minimum:

1. The *Contractor* provides the detail design, supplies, installs, terminates, labels, tests and commissions the all cabling.
2. The *Contractor* decommissions/disconnects the existing power supply cables from the DBs to the new equipment.
3. The *Contractor* removes the old cables and stores them in the dedicated area selected by the *Supervisor*.
4. The *Contractor* issues a test certificate of compliance prior to commissioning of the cables.
5. The *Contractor* provides durable cable numbering /labelling for all cables connected to the equipment; the numbering /labelling is such that maintenance on cables is easily achieved.
6. The *Contractor* secures all cables installed with suitable cable glands, straps or clamps on racks, control cubicles etc.
7. The *Contractor* submits the cable schedules for all cables, inclusive of the origin, target, type, size and termination details to the *Employer*. The *Contractor* uses Template 240-56176097: Electrical Cable Schedule.
8. The *Contractor* provides AC power supply cables that are 4-core, PVC insulated power cable (copper conductor), with low halogen emission flame-retardant PVC outer sheath and bedding.

9. The *Contractor* provides DC power supply cables that have high conductivity, are flexible, flame-retardant PVC insulated, stranded copper conductors.
10. The *Contractor* reuses existing cable routes and cable racks. If it is not feasible to use the existing racks, it is the responsibility of the *Contractor* to provide and install new racks.
11. On completion of the installation, the *Contractor* issues a Certificate of Compliance (CoC) as stipulated in SANS 10142-1 to the *Employer* as per the Occupational Health and Safety Act, (OHS Act 85 of 1993).
12. The *Contractor* provides the cabling in accordance with the following technical guidelines and specifications:
 - a. SANS 10142-1- Wiring Premises
 - b. 240-56227443 - Requirements for Control and Power Cables for Power Stations Standard.
 - c. 240-56176852 – Essential Power supplies for power station Standard.
 - d. 240-56356396 – Earthing and Lightning protection.

3.3 Other requirements of the *Contractor's* design

3.3.1. Project Phases

1. The *Contractor* undertakes all phases of engineering and design from investigation, system engineering and design, through technical clarification, design freeze, procurement, and production engineering to installation, commissioning and testing. The *Contractor* addresses the following throughout execution of the project phases:
 - a. The *Contractor* incorporates all relevant electrical, C&I and third-party documentation into its own documentation to ensure a consistent and integrated documentation system.
 - b. The *Contractor* designs, engineers, commissions and tests all interfaces forming part of the *Contractor's* scope of work.
 - c. The *Contractor* is responsible for the detailed engineering of the field interfaces and the internal replacement RTU interfaces, covering both hardware and software configurations, to ensure full compatibility with the existing RTU control systems.
 - d. The *Contractor* implements online changeovers as the baseline methodology, ensuring continuous operation of the RTU control systems during replacement activities. Any requirement for plant outages is identified, justified, and declared at tender stage, and is subject to the *Project Manager's* acceptance. The *Contractor* complies with the detailed requirements set out in Section 3.2.5, when planning and executing all changeovers.

- e. The *Contractor's* design and engineering considers the performance requirements specified for the replacement RTUs within the existing RTU control systems. An integrated and functional RTU solution is provided which meets the safety, reliability, availability, operability, and maintainability criteria, as well as binary control, sequential control, protection functions, supervisory control functions, and information sharing functions.
- f. The *Contractor* provides the required documents at each phase of the *Works* in accordance with the *Accepted Programme* and upon *Completion* of each section of the *Works*, as specified in the VDSS. All such documents are submitted by the *Contractor* for acceptance by the *Project Manager*.

3.3.2. Investigation Phase

1. The *Contractor*, together with the *Project Manager*, clarifies all project management issues during the investigation phase. The *Contractor* validates all documentation provided by the *Employer* against the existing installation to enable detailed engineering and design of the AGC RTU, Generator Plant A RTU and Generator Plant B RTU, ensuring compatibility within the existing RTU control systems.
2. The *Contractor* benchmarks the current performance of the existing RTUs within the RTU control systems and uses this benchmark data during commissioning and acceptance testing to demonstrate to the *Project Manager* that equivalent or improved performance has been achieved by the replacement RTUs.
3. The *Contractor* compiles the commissioning procedures, with particular attention to the changeover methodology. Changeovers are to be performed online, always maintaining plant operation. Where online changeover is not reasonably possible, the *Contractor* declares this at tender stage, justifies the need for an outage, and obtains acceptance from the *Project Manager*. Under all circumstances, the *Contractor* ensures that changeovers are conducted safely, without plant damage, and without production losses.
4. The *Employer* makes available to the *Contractor* the existing documentation and drawings referred to in the VDSS at Arnot Power Station.
5. The *Contractor* works directly with the *Employer's* personnel, under liaison with the *Project Manager*, for all technical matters. No intermediate engineering function is involved.
6. The *Contractor's* personnel are authorised for the LAR process at Arnot Power Station during the investigation phase. Before *Completion* of the investigation phase, the *Contractor's* personnel are authorised as Responsible Persons as defined in the Plant Safety Regulations at Arnot Power Station. This requirement remains until the *Defects Date* or the end of the last *Defect Correction Period*.

7. The *Contractor* submits a documentation summary and drawing register to the *Project Manager* and obtains acceptance as a prerequisite to *Completion* of the investigation phase.

3.3.3. System Engineering and Design Phase

1. During this phase, the *Contractor* develops the detailed design to ensure that the replacement RTUs (including their I/O modules and interfaces) integrate seamlessly into the existing RTU control systems. This includes verification of all hardware and software interfaces, and the ability of these interfaces to provide consistent and reliable connections with the AGC, Generator Plant A, and Generator Plant B RTU control systems and their external systems.
2. In this phase, the *Contractor* applies all applicable ground rules, design procedures, quality requirements, conventions, descriptions, symbols, representation of information, and methods for finalising the design. The *Contractor* ensures that the replacement RTUs comply with the existing power supply requirements, process operating and control philosophies, supervisory control arrangements, information sharing conventions, and alarming philosophies of the existing RTU control systems.
3. The *Contractor* translates the functional and performance requirements into a conceptual design and presents this to the *Project Manager* for acceptance before proceeding with the detailed design. Overall concepts are validated and refined by the *Contractor* prior to design freeze.
4. The *Contractor* does not commence with any system-specific design activities until this phase is completed, and a design freeze is formally obtained following technical clarification and acceptance by the *Project Manager*.
5. Once the design freeze is obtained, and the engineering concepts are accepted by the *Project Manager*, the *Contractor* proceeds with the detailed design.
6. The *Contractor* translates the functional and performance requirements into specific hardware and software configurations for the replacement RTUs and their associated interfaces to the existing RTU control systems.
7. On completion of the system engineering and design phase, the *Contractor* presents the complete RTU replacement design, including detailed hardware, software, operating, alarming, and information-sharing arrangements, to the *Project Manager* for acceptance. This review is performed during formal clarification meetings arranged by the *Contractor* in accordance with the *Accepted Programme*.
8. The *Employer* provides assistance to the *Project Manager* for the review and acceptance process, and the *Contractor* ensures these *Employer* activities are planned and reflected in the *Accepted Programme*.

9. The *Contractor* supplies the system engineering and design documentation to the *Project Manager* for acceptance at least five working days prior to the start of the technical clarification meetings, in the number and format defined in the VDSS and *Accepted Programme*.
10. The system engineering and design documentation is complete, logically structured, and prepared in conformity with the agreed documentation summary.

3.3.4. Technical clarification stage

1. During this stage, the *Contractor* clarifies all technical issues with the *Project Manager* to enable progression to fabrication of the replacement RTU equipment, following design freeze.
2. At the initial stage of this phase, the *Contractor* presents the finalised design information for the *Employer's* review and acceptance. This ensures that the replacement RTUs and associated interfaces are fully compatible with the existing RTU control systems.
3. As a minimum, the following are included for clarification and acceptance:
 - a. System functional and performance specifications, demonstrating compliance with the existing RTU control system requirements.
 - b. Confirmation of compliance with existing control and operating philosophies.
 - c. Monitoring system equipment allocation and distribution.
 - d. Power supply distribution design and load calculations.
 - e. Communications and control system networks and protocols.
 - f. Replacement RTU design to ensure compatibility with functional and performance criteria of the existing RTU control systems.
 - g. Cabinet and cubicle layouts and locations, including ventilation and filtration specifications.
 - h. Hitachi Energy MicroSCADA interface design and database mapping.
 - i. Operator displays and navigation in line with existing practices.
 - j. Alarm and event handling consistent with the existing RTU control system.
 - k. Engineering system/station arrangements.
 - l. Diagnostic system/station arrangements.
 - m. Quality assurance and quality control measures and methodologies.
 - n. Interfacing and communication specifications.

- o. Interfacing to field equipment (IDF).
 - p. All hardware and software interfaces required for compatibility.
 - q. Documented proposals of the FAT, installation and commissioning procedures, SIT, and SAT, covering both process control/monitoring functions and verification of plant operating requirements.
 - r. Documented proposals for engineering, maintenance, and operating documentation.
 - s. Documented proposals for engineering, maintenance, and operating training manuals.
 - t. Project phasing, resources, and strategies to meet availability requirements.
 - u. Changeover strategies and roll-out/commissioning methodologies, with emphasis on minimising downtime and enabling online changeovers where practicable.
4. Drafts of all documentation for technical clarification are submitted to the *Project Manager* at least five (5) working days prior to the technical clarification meeting, in accordance with the *Accepted Programme*.
 5. The *Contractor* is responsible for identifying and obtaining all technical information and data required for the design of the replacement RTUs and their integration into the existing RTU control systems. Where such information is not available, the *Contractor* is responsible for generating or deriving the required data (e.g., through site investigation, measurement, or validation) to complete the design.
 6. The *Contractor* presents the documentation control system for acceptance by the *Project Manager* at the technical clarification stage, as a prerequisite to *Completion* of this stage. The documentation control system aligns with the requirements of the VDSS and the *Employer's* document management standards.
 7. The *Contractor* submits the proposed format, content, and layout of all documents forming part of the *Works* to the *Project Manager* for acceptance, as a prerequisite to *Completion* of the technical clarification stage.

3.3.5. Design Freeze stage

1. In this stage, the *Contractor* presents to the *Project Manager* for acceptance all information agreed during the technical clarification stage.
2. Within five (5) working days of *Completion* of the technical clarification phase, the *Contractor* provides the following documentation, in accordance with the *Accepted Programme*:
 - a. All documents fully describing the functional and physical design of the *Works*, limited to the replacement RTUs and their integration into the existing RTU control systems.

- b. Build-to specifications for all interfaces, hardware, application software, networks, power supplies, distribution, isolation facilities and earthing associated with the replacement RTU equipment.
 - c. HMI displays, logs, and database configurations relevant to the RTU replacement and its interfaces.
 - d. Control, operating, alarming and information-sharing documentation as required for the RTU replacement to operate seamlessly within the existing RTU control systems.
 - e. Detailed project execution processes, including installation, commissioning, and online changeover procedures and methodology.
 - f. Proposed FAT, SIT, SAT and operational test procedures and methodologies. These cover both process functional/performance requirements to be validated, and the control and monitoring functionality of the replacement RTUs.
 - g. QA methodologies to be applied to the replacement RTUs and their integration.
 - h. Quality control check-sheets and procedures.
 - i. The Functional Design Specification (FDS), which consolidates the final performance, functionality and equipment specifications of the replacement RTUs, as compiled and finalised during the technical clarification phase.
 - j. A summary of the outcomes of all technical clarification meetings.
 - k. The format and content of all operating, engineering and maintenance manuals and drawings, and operating/engineering/maintenance training manuals, as clarified and agreed during this stage.
3. The *Contractor* supplies two (2) draft copies of the operating, maintenance and engineering manuals and drawings not later than fifteen (15) days prior to *Completion* of the design freeze stage. *Project Manager* acceptance is a prerequisite to *Completion* of this stage.
 4. The *Contractor* obtains *Project Manager* acceptance of the complete system engineering and design phase documentation as a prerequisite to *Completion* of the design freeze stage and prior to commencement of the next project phase.

3.3.6. Production engineering phase

1. During this phase, the *Contractor* completes all production engineering activities, i.e. the translation of requirements finalised during the technical clarification and design freeze stages into detailed deliverables necessary for the replacement RTUs and their integration into the existing RTU control systems to form a fully functional solution.

2. The *Contractor* submits the following documentation to the *Project Manager* at least ten (10) working days prior to FAT, in line with the *Accepted Programme*:
 - a. Two copies of the finalised design documentation.
 - b. Two copies of the relevant QA and QC documentation.
 - c. Two copies of the detailed procedures covering installation, online changeover, commissioning, and decommissioning of the existing *Employer's* RTUs.
3. Review and acceptance by the *Project Manager* does not relieve the *Contractor* of responsibility for the correctness of the design or for ensuring that the *Works* satisfy the requirements of the *Works Information*.
4. Two copies of all other production engineering design documentation, prepared in conformity with the system engineering and design phase documentation, are issued by the *Contractor* to the *Project Manager* for acceptance at least ten (10) working days prior to the commencement of any procurement, fabrication, detailed design or construction, as per the *Accepted Programme*.

3.3.7. Procurement and fabrication stage

1. The *Contractor* coordinates and executes all procurement, inspection, expediting, delivery, and quality control activities for Plant, Materials, and *Equipment* required to replace the existing *Employer's* RTUs and integrate them into the existing RTU control systems, as defined in the *Works Information*.
2. All procurement and fabrication activities are carried out strictly in accordance with the approved design freeze documentation, applicable standards, and the VDSS.
3. The *Contractor* ensures that all items procured are inspected, tested, and verified prior to shipment, and that full traceability records (including inspection and test certificates) are provided to the *Project Manager* for acceptance.

3.3.8. Factory acceptance testing (FAT) and delivery stage

1. Prior to transportation of the replacement RTUs and associated components to *Site*, the *Contractor* conducts FAT. During FAT, the *Contractor* demonstrates that the replacement RTUs, including I/O modules and software configurations, meet all requirements of the *Works Information* and operate compatibly within the existing RTU control systems.
2. FAT procedures are compiled by the *Contractor* and submitted to the *Project Manager* for acceptance during the technical clarification phase, in line with the *Accepted Programme*.
3. All hardware and software required for the replacement RTUs are made available and fully operational before FAT commences. Following FAT, the replacement RTUs undergo a

continuous run test of 120 hours, with simulated inputs, without failure of hardware, software, or functions.

4. The *Contractor* performs a complete functional test of each replacement RTU and its interfaces (MicroSCADA, National Control, ABB P14 DCS) to demonstrate full operability prior to delivery to *Site*.

3.3.9. Factory Acceptance Testing Minimum Requirements

1. The *Contractor* is fully responsible for planning, preparing, and executing the FAT in accordance with IEC 62381 and the *Works Information*. The *Contractor* ensures that the facilities, tools, test *Equipment*, and test environments are adequate to conduct a comprehensive FAT.
2. The *Contractor* demonstrates, using simulated inputs and test conditions, the correct functioning of each individual device, module, and the replacement RTU, including redundancy and failover functions. As a minimum, the *Contractor* tests:
 - a. The replacement RTU functions, performance, and module failover in accordance with IEC 62381 and the requirements of this *Works Information*.
 - b. Power supply functions, redundancy, and failure handling.
 - c. Control and communication network functions, redundancy, and failure handling.
 - d. I/O functions, performance, and failure handling.
 - e. Common mode failures (e.g. power supplies, network devices).
 - f. HMI displays, SOE display, log functions, and performance.
 - g. Process server functions and performance relating to RTU control system signals, information, and control.
 - h. Engineering and diagnostic station functions, performance, failure handling, and notification.
3. The *Contractor* is responsible for ensuring that correct functioning of all hardware and software is demonstrated in terms of the *Works Information* and IEC 62381.
4. The purpose of FAT is to prove that the *Contractor's* RTU replacement solution is fully functional and compliant before shipment. Successful FAT does not relieve the *Contractor* of responsibility for the correct functioning of the system at *Site* or during SAT.
5. The *Contractor* prepares and submits the FAT procedures (including test conditions, acceptance criteria, and test dates) for *Project Manager* acceptance. The *Contractor* makes all necessary arrangements for *Employer's* and *Supervisor's* participation in FAT.

6. The *Contractor* bears full responsibility for all corrective actions, re-testing, and costs arising from non-compliance or failure during FAT, until the replacement RTU equipment meets the *Works Information* requirements.

3.3.10. Construction and erection phase

1. The *Contractor* is fully responsible for the installation, integration, and physical erection of the replacement RTU equipment, cubicles, and associated systems at *Site* in accordance with the *Works Information*.
2. The *Contractor* undertakes the following activities at a minimum:
 - a. Install and integrate the replacement RTUs within the existing RTU control systems.
 - b. Interface the replacement RTUs with all remaining plant systems and field equipment (IDF) as per *Employer* requirements.
 - c. Install and test all communication and control networks required for proper operation.
 - d. Erect and install all replacement RTU equipment inside the designated cubicles, including any required infrastructure in the equipment room.
 - e. After decommissioning of old equipment, restore the physical location (e.g. equipment rooms, cable routes) to an acceptable state, free of *Defects*, and present it for *Project Manager* acceptance.
 - f. Where temporary installation outside the cubicle is necessary, the *Contractor* ensures the equipment is mounted inside the cubicle at the earliest opportunity, once the existing *Employer's* RTU has been removed.
 - g. Provide, store, and manage all temporary *Works*, cabling, consumables, and materials necessary for construction and changeover.
3. The *Contractor* is responsible for the quality, completeness, and correctness of all *Works* executed during the construction and erection phase. Review or acceptance by the *Project Manager* does not relieve the *Contractor* of responsibility for proper execution and compliance.

3.3.11. Commissioning phase

1. Each individual replacement RTU is subjected to commissioning. This includes both subsystem-level testing and integrated system-level testing of the RTU control system. Commissioning is planned and executed in line with plant operational conditions and production requirements. The *Contractor* adjusts the programme, where necessary, to accommodate plant availability, and confirms the final arrangements with the *Project Manager* at least two (2) working days prior to commissioning.

2. In the event of a problem during commissioning of the replacement RTUs, it must be possible to revert to the existing *Employer's* RTU within one (1) hour. The rollback procedure is demonstrated during the changeover process and forms part of the *Contractor's* responsibility to ensure system availability.
3. The *Contractor* prepares all test documentation and final commissioning procedures for the replacement RTUs. These documents provide for recording results and signatures of both parties to confirm successful testing in accordance with the agreed procedures and compliance with the *Works Information*. The *Contractor* submits these documents to the *Project Manager* for acceptance at least three (3) weeks prior to commissioning and testing, and they are shown in the *Accepted Programme*.
4. All documentation, including manuals and drawings for the replacement RTUs, is in place before the commencement of the relevant tests. Documentation is incorporated into the commissioning and testing manuals with full details of testing methods and acceptance criteria.
5. The *Contractor* provides notification to the *Supervisor* two (2) weeks prior to commissioning and testing, and this is shown in the *Accepted Programme*. The *Supervisor* inspects all activities during commissioning and is present whenever tests are performed. Waiving of attendance by the *Supervisor* does not relieve the *Contractor* of responsibility for compliance with the *Works Information*.
6. Any additional tests requested by the *Supervisor* are performed during commissioning to prove compliance with the *Works Information*, regardless of tests already completed at FAT or during erection.
7. The *Contractor* provides and maintains all test and calibration *Equipment* to the required accuracy, proven with valid certification by an approved authority to be better than $\pm 0.1\%$. The type and class of equipment is subject to acceptance by the *Supervisor* and may be verified by SABS if required.
8. The *Contractor* provides a test certificate for each replacement RTU down to the individual signal level. The certificate format is submitted to the *Supervisor* for acceptance prior to use. Test results in the form of check sheets are submitted to the *Project Manager* for acceptance at each stage before progressing further.
9. The *Contractor* supplies all *Equipment*, tools, software, and resources necessary for testing and commissioning. The *Supervisor* co-ordinates *Employer* personnel where assistance is required; however, full responsibility for the execution, accuracy, and performance of the replacement RTU remains with the *Contractor*.

10. Where various components form part of the integrated RTU control system, the *Contractor* assumes full responsibility for the correct integration, configuration, functioning, and performance of the system, including the replacement RTU and all associated interfaces. In the event of *Defects*, the *Contractor* investigates the cause, rectifies the *Defect*, and re-tests the system to confirm compliance.
11. Cold commissioning is carried out by the *Contractor* as part of the overall commissioning phase. Cold commissioning includes functional tests of all measurement loops, signal loops, binary controls, analogue monitoring and alarms, verified up to the Hitachi Energy MicroSCADA.
12. Hot commissioning is performed by the *Contractor* once cold commissioning has been successfully completed. Before hot commissioning begins, the *Contractor* certifies that the replacement RTU and associated equipment are in a safe and suitable condition, subject to acceptance by the *Project Manager*.
13. During hot commissioning, the *Contractor* tests and verifies the complete RTU control system end-to-end, ensuring all signals from the IDF (field equipment) through to the Hitachi Energy MicroSCADA HMIs are fully operational. Where *Employer* assistance is required, the *Contractor* submits a written request to the *Project Manager* at least five (5) working days in advance.
14. Hot commissioning of the replacement RTUs is a prerequisite for *Completion* of the commissioning phase. Successful hot commissioning, witnessed and accepted by the *Project Manager*, confirms the RTU control system as fully integrated, operational and ready for handover.

3.3.12. Commissioning documentation requirements

1. The *Contractor* prepares comprehensive test documentation and final commissioning procedures for each replacement RTU, fully aligned with IEC 62381 (Automation Systems in the Process Industry – FAT, SAT and SIT). These documents include space to record test results and to provide signatures of both parties confirming that tests have been executed in accordance with mutually agreed procedures, successfully meeting the functional and performance requirements of the *Works Information*. All documentation, manuals, and drawings for the replacement RTUs are compiled and made available before any tests commence. The *Contractor* submits this documentation to the *Project Manager* for acceptance at least three (3) weeks prior to commissioning and testing, as shown in the *Accepted Programme*.

2. All documentation is consolidated into the commissioning and testing manuals, providing full details of the methods, procedures, acceptance criteria, and references to IEC 62381 standards.
3. The *Contractor* provides written notification to the *Supervisor* at least two (2) weeks prior to the start of commissioning and testing, in accordance with the *Accepted Programme*. The *Supervisor* inspects all parts during commissioning and is present whenever tests are performed by the *Contractor*. If the *Supervisor* elects to waive witnessing any test, this does not relieve the *Contractor* of his full responsibility for compliance.
4. The *Contractor* performs any additional tests required by the *Supervisor* during commissioning to demonstrate compliance with the *Works Information*, regardless of whether similar tests were already performed at the manufacturer's facility (FAT) or during earlier stages.
5. The *Contractor* provides and maintains all test and calibration *Equipment* necessary for commissioning, ensuring that the equipment has proven accuracy better than $\pm 0.1\%$ and is certified by an approved authority. Certificates are presented to the *Supervisor* on request. All test *Equipment* is subject to acceptance by the *Supervisor*, and the *Supervisor* may require that the calibration be verified independently (e.g., by SABS) at any stage of testing.
6. The *Contractor* provides a test certificate for each replacement RTU, covering verification down to the individual signal level. The *Contractor* submits the proposed certificate format to the *Supervisor* for acceptance prior to use.
7. The *Contractor* submits test results in the form of signed check sheets after each stage of commissioning and testing. Acceptance by the *Project Manager* of these results is required before the *Contractor* proceeds to the next phase.
8. The *Contractor* supplies all *Equipment*, tools, and resources required to carry out commissioning and testing in full.
9. The *Supervisor* coordinates the overall commissioning of equipment forming part of the RTU control systems; however, the *Contractor* remains solely responsible for the correct functioning, integration, and performance of each replacement RTU and its interfaces with the plant and existing systems.
10. In cases where the replacement RTU interfaces with external components, systems, or subsystems, the *Contractor* is fully responsible for ensuring correct integration, seamless functionality, and performance of the RTU control system as a whole.
11. Should any incorrect functioning or *Defect* be identified during commissioning, the *Contractor* promptly investigates, diagnoses, and rectifies the issue. Where the fault lies within

Contractor-supplied *Equipment*, plant, or materials, the *Contractor* corrects the *Defects* before commissioning proceeds further.

12. Analogue inputs are simulated or injected at the field device level using a Memocal or equivalent/better device. The *Contractor* demonstrates that the replacement RTUs performs in compliance with the *Works Information* and IEC 62381 commissioning requirements. Upon *completion*, the *Contractor* issues formal test certificates for each replacement RTU tested and accepted.

3.3.13. Inspection Checklists and Certification of Activities

1. The *Contractor* records the results of all inspections, tests, and activities performed in accordance with the *Contractor's* quality control (QC) procedures and plans on standardized checklists and certificates.
2. The checklists and certificates include, as a minimum:
 - a. Identification of the system, subsystem, or component inspected/tested.
 - b. Reference to the applicable procedure, test specification, or drawing.
 - c. The acceptance criteria.
 - d. Actual measured results or observed outcomes.
 - e. The date, time, and location of the activity.
 - f. Names and signatures of the *Contractor's* responsible person performing the inspection or test.
 - g. Signature and comments of the Supervisor (if witnessing was required).
3. Completed checklists and certificates form part of the permanent quality records for the *Works*. They are collated by the *Contractor* and submitted to the *Project Manager* as part of the turnover and as-built documentation package.
4. The *Contractor* ensures that no inspection or test is considered complete until the corresponding checklist or certificate has been properly filled in, signed, and submitted.

3.3.14. Site Integration Test (SIT) Stage

1. The *Contractor* performs the SIT to verify the correct performance of the replacement RTU and its associated communication networks when integrated into the overall RTU control system. The primary purpose of the SIT is to ensure safe operation of plant and personnel, functional compliance with the *Works Information*, and validation of interoperability with existing systems before commissioning commences. The SIT is carried out in accordance with IEC 62381 (Automation Systems in the Process Industry – FAT, SAT and SIT).

2. The *Contractor* prepares and submits the proposed SIT test procedures and the test schedule to the *Project Manager* for acceptance during the System Engineering and Design Phase. The final SIT procedures are submitted to the *Project Manager* at least ten (10) working days prior to the scheduled SIT date, and the *Contractor* shows these dates in the *Accepted Programme*.
3. The *Contractor* provides all test *Equipment*, tools, software, and resources required to perform SIT on individual modules, sub-assemblies, and the integrated RTU control system. The *Contractor* maintains detailed records of each SIT in a logbook describing the test undertaken, the time and date of commencement, the duration of the test, the acceptance criteria, and the results obtained. The *Contractor* submits the completed records to the *Project Manager* for acceptance upon completion of each SIT.
4. If a test is unsuccessful, the *Contractor* records the matter as a *Defect*, analyses the cause, and reports the solution to the *Project Manager*. Where the *Defect* is minor, the *Contractor* corrects the issue and repeats the affected test. Where the *Defect* is major, such as hardware or software failure that compromises the RTU control system, the SIT is terminated.
5. In the event of a major *Defect*, the *Contractor* rectifies the *Defect*, verifies the correction through diagnostic testing, and repeats the SIT in full. Upon successful completion of the SIT, the replacement RTU is confirmed as correctly integrated, functionally compliant with this *Works Information*, and available for cold commissioning (functional testing).

3.3.15. Site Acceptance Testing (SAT)

1. The *Contractor* provides a detailed SAT procedure for the replacement RTU. The procedure is submitted to the *Project Manager* for acceptance at least ten (10) working days prior to the commencement of the SAT, and the planned test dates are shown in the *Accepted Programme*. The procedure includes all activities, acceptance criteria, test configurations, records, and documentation required for the SAT stage.
2. Following the completion of installation and commissioning, the *Contractor* demonstrates to the *Supervisor* and *Project Manager* that the replacement RTU performs correctly and fully complies with the *Works Information*. The SAT includes, as a minimum:
 - a. Verification of analogue monitoring, digital control, and alarm functions, with results logged and cross-referenced to those documented at design freeze and tested during FAT and Hot Commissioning.
 - b. Full demonstration of all functional and performance requirements of the RTU control system at every level, including redundancy, communications, and integration with National Control, Hitachi Energy MicroSCADA, and ABB P14 DCS.

3. *The Contractor* provides test results, check sheets, and certification of SAT completion to the *Project Manager* for acceptance.

3.4 Safety Requirements

1. The *Contractor* complies with the latest revision of the Eskom Generation Plant Safety Regulations as well as the Occupational Health and Safety Act (OSHACT).
2. Safety is treated as the highest priority. The *Contractor* ensures that all personnel complete site induction and maintains an Eskom approved safety file at all times. Work is carried out under a Permit to Work supplied by the *Employer*, with additional supervision provided where required.
3. Where heavy equipment is to be moved during construction or installation, rigging is carried out only by qualified and certified riggers under the *Contractor's* responsibility.

3.5 Documentation requirements

1. The *Contractor* provides all engineering drawings in accordance with the VDSS attached in Appendix 1.
2. The *Contractor* supplies all documentation in English and submits three copies in hard print as well as soft copies of the following final as-built deliverables:
 - a. General arrangement drawings.
 - b. Schematic and wiring diagrams.
 - c. Cubicle wiring diagrams.
 - d. Updated cable schedules.
 - e. Updated input/output (IO) lists.
 - f. Updated interface drawings showing connections to existing systems.
 - g. Operation and maintenance manuals.
3. The *Contractor* ensures that all drawings and documentation are prepared using an Eskom-approved template and accurately reflect the final installed and commissioned condition of the *Works*.
4. Acceptance of the as-built documentation and drawings by the *Project Manager* is a prerequisite to *Completion*. The Contractor remains responsible for correcting any omissions, inaccuracies or *Defects* in the as-built documentation until acceptance is obtained.

3.5.1 Drawings

1. The *Contractor* provides a circuit diagram which reflects the system design, identifies components which will include the identification of all components by name, serial number and manufacturer name. The serial number on the circuit diagram is also recorded on a list with the component description by the *Contractor*.

3.5.2 Technical data

1. The *Contractor* includes the following data in the proposal:
 - a. List of spare parts recommended for start-up and normal maintenance purposes
 - b. List of the special tools furnished for maintenance
 - c. Complete tabulation of utility requirements, e.g. electricity, air, etc
 - d. Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment
2. Procurement of components by the *Contractor* shall not proceed without the *Employer's* review and acceptance of the components selected.

3.5.3 Parts Lists and Recommended Spares

1. The *Contractor* supplies a comprehensive spares list, based on the recommendations of the OEM and recognised best maintenance practices.
2. As part of the *Works*, the *Contractor* provides one full set of spares, including at least one of each module, to be handed over to the *Employer* for storage at the Arnot Stores. A preliminary comprehensive spares list, including all relevant part numbers, identification numbers and specifications, is submitted with the tender. The *Contractor* confirms the final spares list no later than six (6) weeks prior to *Completion* and submits it to the *Project Manager* for acceptance. All spares are delivered before *Completion* to enable their inclusion in the final assessment.
3. The *Contractor* submits complete parts lists for all equipment and accessories supplied. These lists include part names, the manufacturer's unique part numbers, and the materials of construction identified against the applicable International Standards.
4. Interchangeable parts are clearly identified by the *Contractor*. Parts modified from standard dimensions or finishes to meet specific performance requirements are uniquely identified by a dedicated part number.
5. Standard purchased items are identified on the parts lists by the original manufacturer's name and part number.

6. On each complete parts list, the *Contractor* indicates all parts recommended as start-up or maintenance spares and specifies the recommended stocking quantities of each item.
7. The *Contractor* provides datasheets for all individual components supplied, including the necessary technical and performance data.

3.5.4 Installation, Operation, Maintenance and Technical Data Manuals

1. The *Contractor* provides complete written instructions and all required drawings to enable the *Employer* to correctly install, operate and maintain all equipment supplied under the *Works*.
2. The *Contractor* prepares the manuals specifically for the equipment supplied, ensuring they are relevant to the *Employer's* installation and operating environment.
3. All information necessary for the proper installation of the equipment is compiled by the *Contractor* into a dedicated installation manual.
4. After successful completion of all specified tests, the *Contractor* supplies a comprehensive manual containing the required operating and maintenance instructions.
5. In addition to covering operation under all specified process conditions, the *Contractor* ensures the manual also contains separate sections describing operation under transient or abnormal conditions. As a minimum, the following are included:
 - a. Start-up procedures.
 - b. Normal shutdown procedures.
 - c. Emergency shutdown procedures.
 - d. Operating limits.
 - e. Depressurisation instructions.
 - f. Adjustment procedures.
 - g. Routine operational procedures.
 - h. Performance data.
 - i. As-built data, including datasheets.
6. The *Contractor* compiles and provides detailed maintenance manuals for all equipment. These manuals include clear guidelines for disassembly, inspection, identification of wear or deterioration, repair or replacement of failed components, and reassembly.
7. The *Contractor* also compiles and provides a troubleshooting guide specific to the RTU equipment and associated interfaces. The guide details possible faults, likely causes, diagnostic steps, and corrective measures.

3.6 Maintenance requirements

3.6.1 Maintenance Planning

1. The *Contractor* compiles and submits a comprehensive maintenance strategy covering all components of the replacement RTU and associated interfaces within the RTU control systems. This includes all electrical and electronic modules, power supplies, communication devices, and I/O hardware. The maintenance strategy is submitted to the *Project Manager* for acceptance.
2. The *Contractor* ensures that the replacement RTU design allows maintenance activities on individual components or modules to be performed without requiring shutdown of the replacement RTU and its control systems, thereby maintaining system availability.
3. The *Contractor's* design incorporates redundancy in accordance with the requirements of clause 3.2.3 (2), ensuring that critical functions remain operational during maintenance or failure of individual components.
4. The *Contractor* designs the replacement RTU solution with ease of maintenance as a key consideration, ensuring that inspection, testing, repair, and replacement of components can be carried out efficiently and safely, with minimal impact on system operability and availability.

3.6.2 Test and support equipment required

1. The *Contractor* provides all specialised test and support *Equipment* necessary for the inspection, testing, calibration, and verification of any of the replacement RTU components supplied as part of the *Works*.
2. All test and support *Equipment* supplied by the *Contractor* is clearly identified with part numbers, manufacturer details, and calibration certificates traceable to an accredited authority.
3. Where proprietary or OEM-specific test *Equipment* is required to maintain or troubleshoot the replacement RTU, the *Contractor* supplies such *Equipment* to the *Employer* as part of the *Works*.
4. The *Contractor* ensures that any software-based test tools, diagnostic applications, or interface devices are licensed for the lifetime of the equipment, with no recurring license costs to the *Employer*.
5. The *Contractor* submits a list of all test and support *Equipment*, including calibration intervals and maintenance requirements, to the *Project Manager* for acceptance.

6. The *Contractor* provides comprehensive training for the *Employer's* personnel on the correct use, calibration, maintenance, and troubleshooting functions of all test and support *Equipment* supplied under the *Works*.

3.6.3 Engineering, Maintenance and Operating personnel training requirements

1. The *Contractor* provides training to the *Employer's* personnel to ensure full competency in the operation, configuration, maintenance, and troubleshooting of the replacement RTU and its components.
2. The *Contractor* provides basic training to all designated maintenance staff on the operation, inspection, and routine maintenance of the replacement RTU components.
3. The *Contractor* provides advanced training to senior technicians and engineers on complex replacement RTU functions. Training for engineers covers the setup and configuration of the replacement RTU, including adding and removing signals through both hardwired interfaces and bus communication. Training for maintenance staff covers practical fault-finding, diagnostics, and preventative maintenance of the replacement RTU.
4. The *Contractor* arranges at least two structured training sessions, scheduled on separate occasions, to accommodate shift coverage and operational availability. The number of *Employer's* employees to be trained is estimated to be twenty.
5. Training includes the provision of appropriate training aids, manuals, and course material. Each trainee receives an individual copy of all relevant documentation and manuals.
6. The *Contractor* includes in the scope of supply any specialised tools or test *Equipment* required to support training, commissioning, and maintenance. Such items are handed over to the *Project Manager* at project *Completion* for the *Employer's* ongoing use.

3.6.4 Accessibility

1. The *Contractor* designs and manufactures the replacement RTU such that all components are accessible, safe to adjust, service, and maintain without requiring the removal of unrelated equipment.
2. The *Contractor* ensures that components are arranged and installed in a way that does not obstruct adjustment, servicing, or maintenance activities, and complies with the *Employer's* requirements for ergonomics and safe working practices.
3. The *Contractor* gives particular attention to the location and layout of components requiring regular inspection, maintenance, or replacement to minimise downtime, improve maintainability, and ensure safe working clearances.
4. Accessibility design and installation practices by the *Contractor* align with the *Employer's* standards for ergonomics, passageways, and maintenance access, ensuring that personnel

movement and equipment handling are not restricted during operation or maintenance activities.

3.7 Quality requirements

1. The *Contractor* performs the *Works* in accordance with the *Employer* standards and procedures.
2. No work will be done by the *Contractor* without QCPs (Quality Control Plans) and ITPs (Inspection and Test Plans) that is accepted by the *Employer*.
3. The *Contractor* therefore submits a QCP to the *Project Manager for acceptance* for each item installed with adequate time remaining before that part of the work is to be commenced.
4. Each QCP contains a space, separate from the individual interventions points, where the names of the nominated quality representative from each party will print their names and sign next to it; this is to aid signature identification.
5. Intervention points will be signed as the work progresses, and no backdating will be allowed. Notification for interventions to be in writing and to be done at least 24 hours in advance for interventions on *Site* and at least 72 hours in advance for work outside *Site*.
6. The *Contractor's* QCPs and related documentation to be subject to comment and acceptance by the *Employer's* quality control personnel.
7. The *Contractor's* QCPs make provision for signatures for interventions by at least the *Contractor's* QC representative, the *Employer's* engineering department and the *Site* AIA representative.
8. The following minimum hold points must be included for the *Employer's* Quality Control department:
 - a. Initial acceptance of QCP's.
 - b. Marking of cut lines.
 - c. Final inspection.
 - d. Final data book review.

3.8 APPENDICES

A. APPENDIX 1 – VENDOR DOCUMENTATION SUBMISSION SCHEDULE

B. APPENDIX 2 – DATA BASE

C. APPENDIX 3 – LOSS DIAGRAMS

D. APPENDIX 4 – LIST OF EMPLOYER STANDARDS